Mind the Gap

Estimated Duration of Inadequate Sedation After Rapid Sequence Induction and Intubation in Critically Ill Patients

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BACKGROUND: Induction agents are administered to decrease the risk of discomfort, awareness, and psychological sequelae during procedural paralysis (eg, rapid sequence intubation). The expected duration of nondepolarizing neuromuscular blocking agents exceeds that of induction sedatives. The resulting sedation gap may increase the risk of awake paralysis.

RESEARCH QUESTION: The objective of this study was to elucidate the prevalence and duration of sedation gaps in critically ill patients undergoing bedside procedural paralysis.

STUDY DESIGN AND METHODS: This was a retrospective cross-sectional study of critically ill adults who received rocuronium for a bedside procedure. The primary outcome was the sedation gap, which was the cumulative time of inadequate sedation during presumed paralysis (ie, 60 min after rocuronium). Secondary outcomes included the sedation gap when a pharmacist was present at the bedside. Descriptive statistics were used for baseline characteristics and the primary outcome. Log-rank and Mann-Whitney *U* tests were used to analyze secondary outcomes.

RESULTS: Eighty patients were included in the final analysis. The average age was 60 years and 57% of patients were male. The most common indication for procedural paralysis was rapid sequence intubation (99%). Most procedures were performed in the ED (55%), followed by the ICU (43.8%). Eighty-five percent of patients experienced a sedation gap of any duration. The median sedation gap was 19 min (interquartile range [IQR], 4-47.5 min). The probability of initiating adequate sedation was higher when a pharmacist was present at the bedside (hazard ratio, 1.49 [95% CI, 1.42-1.55], bootstrapping log-rank test). The median sedation gap with a pharmacist (11 min [IQR, 3-27.5 min]) was significantly lower than without a pharmacist (40 min [IQR, 17-55 min]; $P = .0115$, Mann-Whitney *U* test).

INTERPRETATION: In this critically ill cohort, a substantial prevalence and duration of inadequate sedation was experienced after receiving rocuronium for bedside procedures. Further study is needed to identify if sedation gaps correlate with an increased risk of psychological morbidities.

CHEST Critical Care 2024; 2(3):100089

KEY WORDS: critical care; intensive care units; neuromuscular blockade; neuromuscular blocking agents; paralytic; postprocedural delayed awakening; procedural paralysis; rapid sequence induction and intubation; rocuronium; sedation

ABBREVIATIONS: EMR = electronic medical record; IQR = interquartile range; NMBA = neuromuscular blocking agent; RSI = rapid sequence intubation; TOF = train-of-four

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This article was presented as an abstract at the University of California Pharmacy Collaborative Conference, May 24, 2023, Davis, CA; Northern California Society of Critical Care Medicine Spring Research Conference, May 11, 2023, San Francisco, CA; and Society of Critical Care Medicine Critical Care Congress, January 21, 2024, Phoenix, AZ.

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DOI: https://doi.org/10.1016/j.chstcc.2024.100089

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Take-home Points

Study Question: What are the prevalence and duration of sedation gaps after neuromuscular blockade for bedside procedures in critically ill patients? What is the effect of bedside critical care pharmacists on this outcome associated with these procedures?

Results: A retrospective cross-sectional study demonstrated that sedation gaps occurred in 85% of patients who received neuromuscular blockade for a bedside procedure. The median sedation gap was 19 min. Duration of inadequate sedation was reduced substantially when an ICU pharmacist was present.

Interpretation: In this study, a substantial proportion of patients experienced sedation gaps, during which an increased risk of awake paralysis and associated sequalae may be present. A need for further research to understand who is at risk of inadequate sedation and for development of strategies to improve patient care remains.

Neuromuscular blocking agents (NMBAs) are administered commonly to facilitate bedside procedures such as rapid sequence intubation (RSI). In the United States, > 650,000 intubations are performed outside of the operating room annually.[1] Induction agents (eg, etomidate, midazolam, ketamine) are administered concurrently to optimize intubating conditions, to provide immediate sedation, and to decrease the risk of discomfort and awareness during procedural paralysis.

The incidence of awareness with paralysis is as high as 0.2% in patients after general anesthesia[2] and as high as 5.5% to 7.4% in patients who receive rocuronium for RSI in the ED.[3,4] A higher prevalence of awareness with paralysis as well as greater delays in sedative initiation also is associated with rocuronium as compared with succinylcholine during RSI.[3,5,6] Awareness during paralysis has been associated with an increased risk of psychological sequelae such as posttraumatic stress disorder.[2,7,8]

Notably, a shift in practice to using rocuronium has occurred because of perceived advantages in side effect profile.[9] The expected duration of paralysis from rocuronium exceeds that of commonly administered induction sedatives (eg, etomidate, midazolam, and ketamine).[10-14] This difference may lead to an occult sedation gap and consequent awake paralysis. Based on population pharmacokinetic studies, the average duration of action of rocuronium (0.6-1.2 mg/kg) is 60 min, but is highly variable (ie, 15-160 min).[10,15] Critically ill patients experience many of the possible risk factors for prolonged durations, including older age, higher doses, hypothermia, liver disease, renal failure, electrolyte disturbances, and concurrent administration of certain medications.[16-25]

Time to postintubation sedatives after rocuronium commonly has been used as a surrogate outcome to investigate sedation practices in an emergency room setting.[3,5,6,7,26-28] Some of these studies also describe a tendency toward lower doses of postintubation sedatives at certain time points after rocuronium as compared with succinylcholine.[27,28] However, studies are lacking that consider critically ill patients outside of the emergency room, the possibility of prolonged paralysis, dosing of induction agents, and administration and dosing of subsequent sedatives for the full duration of neuromuscular blockade. This study aimed to elucidate the prevalence and duration of sedation gaps in critically ill patients experiencing bedside procedural paralysis.

Study Design and Methods

Study Design, Setting, and Population

This was a retrospective cross-sectional study conducted at a large academic medical center with five adult ICUs (February 2023-April 2023). The study protocol was approved by the institutional review board (identifier: 2030129-1 [April 7, 2023]). Hospitalized adult patients who received rocuronium for a bedside procedure were screened for inclusion. Patients were excluded if they were receiving continuous sedation before the procedure, received additional NMBAs after the procedure, or were undergoing cardiac arrest around the time of the procedure. Patients who received multiple doses of rocuronium during a single admission were eligible for inclusion if clear recovery was documented (eg, extubation, charted movement or arousal) between administrations.

Data Collection and Outcomes

Patients were identified from a list of rocuronium administrations outside the operating room using the electronic medical record (EMR). The list was sorted by date of rocuronium administration, and consecutive patients

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were reviewed for study inclusion to minimize potential selection bias. Patient screening and clinical data collection were performed via manual review.

Baseline demographics, patient location, bedside procedure performed, and indication for mechanical ventilation were collected. Indication for mechanical ventilation was determined by procedure note review; some patients had more than one indication identified. Doses and administration dates and times were collected for rocuronium, induction agents (etomidate, ketamine, midazolam, and propofol), and sedatives (dexmedetomidine, ketamine, midazolam, and propofol) given during the presumed paralysis period.

The durations of action of induction agents were defined as 5 min (etomidate and propofol), 10 min (ketamine), and 15 min (midazolam) based on population pharmacokinetic studies.[10-13] If more than one induction agent was administered, the medication dosed closest to recommended weight-based dosing per respective package insert was considered the primary agent. The weight used for all medication calculations was actual body weight. Adequate postinduction sedation was defined as intermittent midazolam IV boluses $\geq$ 2 mg every 15 min, propofol continuous infusion $\geq$ 20 μg/kg/min, or ketamine continuous infusion $>$ 10 μg/kg/min. A conservative threshold for continuous ketamine infusion rate was chosen because it was used as an adjunct therapy at the study institution. Dexmedetomidine was not considered adequate sedation. In patients whose recorded administration times for rocuronium and induction agent differed by $>$ 2 min, review of procedure notes, nursing notes, and medication dispensing dates and times was completed to determine accuracy of charted administration time. If accuracy of charted administration times remained unclear, the patient was censured from review.

The primary outcome was the cumulative time of inadequate sedation during presumed paralysis. This sedation gap was calculated by subtracting the cumulative time of adequate sedation from the total duration of presumed paralysis, which was defined as 60 min after rocuronium administration. The duration of action for each sedative agent was used to determine the period of sedation. For example, if a patient received etomidate and rocuronium simultaneously, the upper limit of inadequate sedation would be 55 min, given that the presumed etomidate duration was 5 min. Additionally, if propofol was administered at adequate doses for the first 25 min, but then turned off, the remaining 35 min were accounted for as part of the sedation gap. Secondary outcomes included time to initiation of adequate sedation and the sedation gap when assuming a prolonged duration of paralysis, which was defined as 120 min.[29-32]

A nested cohort compared outcomes between groups with and without a pharmacist present to facilitate delivery and preparation of medications during the bedside procedure. Pharmacists at the study center had a high participation rate in ICU procedures between 6:30 AM and 3:30 PM, variable participation between 3:30 PM and 10:00 PM, and 24-h participation in the ED. A pharmacist was considered present at bedside if he or she removed any procedural rocuronium, induction, or sedative agent from an automated dispensing cabinet or documented procedural involvement in the EMR.

Statistical Analysis

Baseline characteristics and medication doses were assessed using descriptive statistics. Sedation gap comparisons were assessed using the Mann-Whitney *U* test and the log-rank test. Bootstrapping with replacement was performed subsequently for 10,000 iterations of the original data set to mitigate the effects of stochastic events in each group: pharmacist present vs pharmacist not present. *P* values of $<$ .05 were considered statistically significant. Statistical analysis was completed using the software programs Microsoft Excel (Microsoft Corporation), Prism (GraphPad Software), and R Studio (Posit Software).

Results

A total of 122 consecutive patients were assessed for inclusion; 80 patients were included in the final analysis (Fig 1). The most common reason for exclusion was continuous sedation before the procedure. The average age was 60 years, and 57% of patients were male. The most common indication for procedural paralysis was RSI (98.8%). Most RSIs occurred in the ED (55.0%) and ICU (43.8%) (Table 1). The primary induction agent was etomidate (90.0%). Most etomidate doses (73.6%) administered were $<$ 0.3 mg/kg (Table 2). The average dose of rocuronium administered was 1.1 $\pm$ 0.2 mg/kg, with 53.8% receiving doses of $>$ 1 mg/kg.

Overall, 68 patients (85.0%; 95% CI, 80.7%-89.3%) experienced a sedation gap of any duration during presumed paralysis (Table 3). For the primary outcome, the median sedation gap during a 60-min period of presumed paralysis after rocuronium administration was

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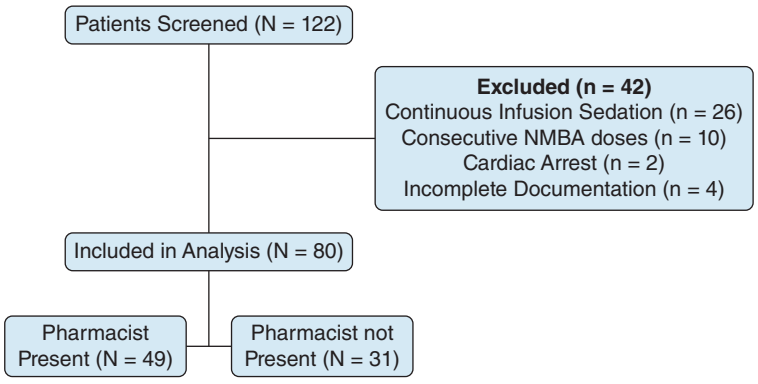
Patients Screened (N = 122)
Excluded (n = 42)
Continuous Infusion Sedation (n = 26)
Consecutive NMBA doses (n = 10)
Cardiac Arrest (n = 2)
Incomplete Documentation (n = 4)
Included in Analysis (N = 80)
Pharmacist Present (N = 49)
Pharmacist not Present (N = 31)

Figure 1 – *Flow diagram showing patient cohort. NMBA = neuromuscular blocking agent.*

19 min (interquartile range [IQR], 4.0-47.5 min) (Fig 2, Table 3). The median sedation gap during a 120-min period of presumed paralysis was 39 min (IQR, 5.3-101.0 min) (Fig 2, Table 3). The probability of initiating adequate sedation was higher when a pharmacist was present at the bedside (hazard ratio, 1.49 [95% CI, 1.42-1.55]; $P < .0001$, bootstrapping log-rank test) (Fig 3). The median sedation gap with a pharmacist at the bedside was significantly lower than without one (11 min [IQR, 3-27.5 min] vs 40 min [IQR, 17-55 min]; $P = .012$, Mann-Whitney U test) (Table 3). Bootstrapping resulted in a median sedation gap of 11 min (IQR, 3-25 min) vs 40 min (IQR, 17-25 min) for pharmacists present vs not present, respectively. The resulting difference of medians was 29 min (95% CI, 11-37 min; $P = .0143$, bootstrapping Mann-Whitney U test).

TABLE 1] Baseline Characteristics

Characteristic	Data (n = 80)
Male sex	46 (57.50)
Age, y	60 ± 17.72
Weight, kg	84 ± 22.71
BMI, kg/m^2	29 ± 6.93
Location	
ED	44 (55.00)
Medical ICU	25 (31.25)
Cardiothoracic ICU	5 (6.25)
Surgical ICU	1 (1.25)
Neurosurgical ICU	4 (5.00)
Non-ICU floor	1 (1.25)
Burn ICU	0 (0.00)
Procedure	
RSI	79 (98.75)
Tracheostomy	1 (1.25)
Indication for mechanical ventilation[a]	
Altered mental status	57 (71.3)
Hypercapnia	36 (45.0)
Hypoxia	51 (63.8)

Data are presented as No. (%) or mean ± SD. RSI = rapid sequence intubation.
[a]Multiple indications for intubation existed.

TABLE 2] Pharmacologic Agents Administered

Pharmacologic Agents Administered	Data (n = 80)
Primary induction agent[a]	
Etomidate	72 (90.0)
Dose < 0.3 mg/kg	53 (73.6)
Dose ≥ 0.3 mg/kg	19 (26.4)
Propofol	2 (2.5)
Ketamine	4 (5.0)
Midazolam	0 (0.0)
Rocuronium dose, mg/kg	1.05 ± 0.2
< 0.6	0 (0.0)
0.6-1	37 (46.3)
> 1	43 (53.8)
Postprocedural sedation within 2 h after NMBA[b]	
Propofol	68 (85.0)
Initial dose ≥ 20 μg/kg/min	48 (70.6)
Initial dose < 20 μg/kg/min	20 (29.4)
Midazolam	
Intermittent injections	30 (37.5)
Continuous infusion	0 (0.00)
Ketamine	1 (1.25)
Initial dose > 11 μg/kg/min	0 (0.00)
Initial dose ≤ 11 μg/kg/min	1 (1.25)
Dexmedetomidine	7 (8.75)
Adjunctive	6 (7.50)
Primary sedative	1 (1.25)

Data are presented as No. (%) or mean ± SD. Dosing weight used was actual body weight. NMBA = neuromuscular blocking agent.
[a]Two patients were intubated without receiving an induction agent.
[b]Postintubation sedation percentages do not add up to 100% because patients could receive multiple sedative agents.

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TABLE 3] Outcomes

Outcome	Overall (n = 80)	Pharmacist Present (n = 49)	Pharmacist Not Present (n = 31)	*P* Value
Sedation gap 1 h after NMBA, No. (%)	68 (85.0)	42 (85.7)	26 (83.9)	.822[a]
Sedation gap 1 h after NMBA, min	18.5 (4-47.5)	11 (3-27.5)	40 (17-55)	.012[b]
Sedation gap 2 h after NMBA, min	38.5 (5.8-101.0)	29 (4-84)	85 (18-115)	.031[b]
No adequate postintubation sedation within 1 h after NMBA	18 (22.5)	9 (18.4)	9 (29.3)	.269[a]

Data are presented as No. (%) or median (interquartile range). NMBA = neuromuscular blocking agent.
[a]Fisher exact test.
[b]Mann-Whitney *U* test.

The predominant postintubation sedative was propofol (85.0%); a substantial proportion of these patients (29.4%) received doses of less than the minimum rate for adequate sedation. Midazolam intermittent injections were administered to 37.5% of patients. Dexmedetomidine was started as an adjunctive agent in six patients and as the primary sedative in one patient (Table 2). For all patients, the median time from end of induction effect to first sedative dose was 6 min (IQR, 0-31.8 min). For the subset of patients who experienced a sedation gap, a delay in initial sedation occurred in 83.8% (n = 57/68), with a median delay to postintubation sedation of 14 min (IQR, 25-55 min). For patients who received an adequate postintubation sedative within 60 min, 39.7% (n = 24/63) experienced interruption(s) in adequate sedation during the expected duration of paralysis (eg, midazolam IV push administered only once). Overall, 18 patients failed to receive any adequate postintubation sedative within 60 min from rocuronium administration: three patients received no postintubation sedative, one patient received only dexmedetomidine, and 14 patients received postintubation sedatives at inadequate doses.

Discussion

Key Findings

This seems to be one of the first studies to calculate the cumulative sedation gap and to quantify precisely the time that critically ill patients were potentially at risk of awake paralysis. In this critically ill cohort, a substantial prevalence and duration of inadequate sedation was experienced after receiving rocuronium for bedside procedures. Therefore, most patients were likely at an increased risk of awake paralysis and long-term psychological morbidities.

The median time to postintubation sedation observed (6 min) was comparable with previously reported delays, which ranged from 8.5 to 35.5 min.[26-28] Initial gaps reported in the literature as mean values ranged from 27 to 34 min; this difference is likely the result of the effect of outliers (ie, positive-skewed distribution).[5,6] Further, previous investigators measured time from rocuronium administration or intubation, which did not account for induction sedation.

No significant difference was found in the frequency with which patients experienced a gap in sedation with or without a pharmacist at the bedside (Table 3).

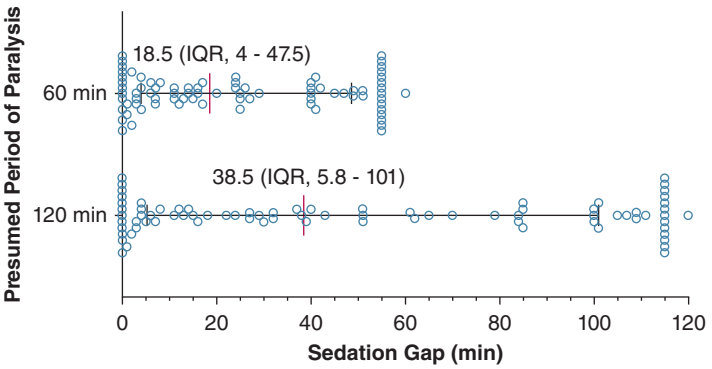

Figure 2 – *Box-and-whisker plot showing the sedation gaps of the 80 included patients and their distribution across quartile segments during periods of presumed paralysis. One patient experienced a sedation gap of > 115 min. IQR = interquartile range.*

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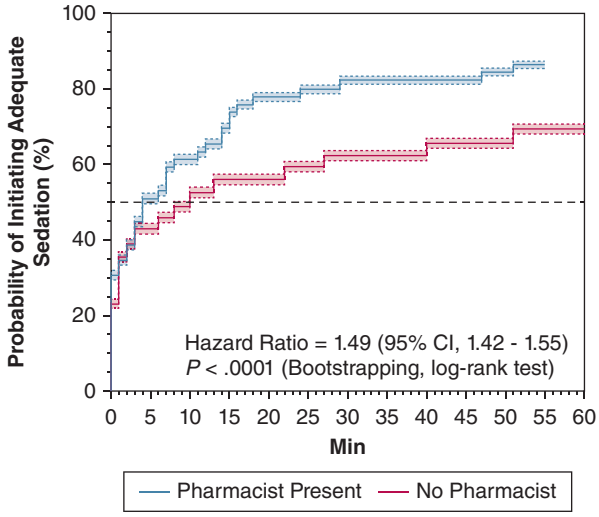

Figure 3 – *Kaplan-Meier curve showing the probability of initiating adequate sedation. If a patient received no postintubation sedation, they were assigned the maximum possible time. If a patient received no induction agent, the initial gap was from rocuronium administration to initial sedative administration.*

However, when a pharmacist was present at bedside, the probability that a patient was initiated on adequate sedation was higher at every time point beyond the first 3 min after the induction period (Fig 3). This affirms previous studies that showed a significant reduction in time to sedation or analgesia when an ED pharmacist was present.[5,33] The urgency of providing sedation may be penetrating bedside practice, as evidenced by a relatively small difference in time to initiation of adequate sedation (Fig 3). However, a substantial difference in median cumulative sedative gap suggests that patients remain at risk of inadequate sedation for the entire duration of paralysis (Table 3). Notably, the sedation gap was reduced by 29 min with a pharmacist present at the bedside during the procedure.

Implications

A combination of several suboptimal characteristics of current RSI workflow likely contributed to significant sedation gaps. First, often a delay in ordering and initiating adequate sedation occurred. This delay probably was the result of competing priorities during RSI, including retrieving medications and supplies, ensuring line access availability, and monitoring patient vital signs.

Second, a shift favoring rocuronium use over succinylcholine for neuromuscular blockade resulted in prolonged periods of paralysis with RSI. This change in practice may have stemmed from concerns over contraindications to succinylcholine use and perceived differences in first-pass RSI success. However, the extended durations of paralysis with rocuronium may not have been matched with commensurate changes in sedative support resulting in sedation gaps.

Third, inconsistent and incongruent dosing of rocuronium and induction agents was observed in this study. Notably, average doses of rocuronium were on the upper end of the recommended dosing range, further increasing the likelihood of prolonged paralysis and inadequate sedation. In contrast, etomidate doses were lower than recommended. Therefore, induction sedation may have been truncated, potentially extending the interval of inadequate sedation.

Fourth, a standardized process to monitor paralytic recovery, such as train-of-four (TOF), was not integrated into the workflow. Additionally, rapid response teams may have bypassed typical workflow and safety protocols (eg, order entry, order verification, and barcode medication administration) to administer NMBAs and induction agents urgently for RSI. Consequently, the primary nurse and team may not have been aware that the patient was paralyzed in the absence of robust communication and documentation.

Each health system must grapple with the challenge of integrating potential solutions to mitigate the risk of awake paralysis. No singular tactic can be expected to intercept the various pathways leading to sedation gaps; therefore, a multifaceted approach is imperative. Clinical decision support tools (eg, order sets and best practice alerts), engagement of bedside pharmacists, use of monitoring devices (eg, peripheral nerve stimulator),

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protocolized handoff after RSI, and education of multidisciplinary teams are all solutions that may reduce the risk of sedation gaps.

RSI and postoperative recovery order sets offer the opportunity to link NMBA and sedative orders, to promote evidence-based dosing, to harmonize administration instructions, to integrate medication decision support (eg, drug-disease interactions), to incorporate monitoring for prolonged paralysis, and to provide quick access to NMBA reversal agents. Clinical decision support also may provide prompts and default options that encourage the use of succinylcholine when appropriate. The primary disadvantage of order sets is that the bedside provider must use them for them to be effective, which requires EMR access, familiarity, and continuous education. In addition, navigating complex order sets creates the potential for delays in urgent or emergent care. Furthermore, overreliance on EMR tools may discourage critical thinking and individualization of patient care, which must be counterbalanced with robust education and training.

Bedside pharmacists may reduce awake paralysis by collaborating with providers and nurses to coordinate order entry, medication preparation and delivery, safe administration, and monitoring. The pharmacist provides dedicated attention to essential pharmacotherapy, allowing team members to focus on other critical responsibilities (eg, gathering airway supplies, charting, and intubation). Unfortunately, a critical care or emergency medicine pharmacist may not be readily available because of competing demands and resource limitations. Notably, pharmacy staff may not be present for many institutions during evenings, nights, and weekends.

A formal process to monitor neuromuscular blocking outside of the operating room may lead to earlier identification of prolonged paralysis. Additionally, reversal agents (eg, sugammadex and neostigmine) may be a reasonable consideration for patients experiencing prolonged paralysis or in contexts where urgent neurologic examination is indicated. Evaluation of paralytic recovery may be based on return of movement or TOF monitoring, although evidence to support use of peripheral nerve stimulators outside of the operating room is limited.[34] Despite concerns for inaccuracy, peripheral nerve stimulation provides the only available objective measurement of the degree of neuromuscular blockade. The usefulness of peripheral nerve stimulation may be improved by performing a baseline TOF on the patient after sedation and before NMBA administration. Finally, these devices may not be readily accessible for many institutions, and their role may be limited during emergent circumstances.

Protocolized communication between health care providers is crucial during emergent RSI when it may be impractical to use order sets before medication administration. Verbal handoff is an efficient method of communication, but its effectiveness may be diminished if stakeholders are not present at the time of RSI completion. Prompt ordering of medications or entering a flag on the patient's profile also would alert other clinicians that RSI has occurred.

Study Strengths and Limitations

This study included a broad population of critically ill patients regardless of indication for mechanical ventilation or ICU stay. Close evaluation of sedation gaps could impact outcomes positively, given the prevalence and negative sequelae associated with awake paralysis.

This study has several limitations. This study was limited by its single-center, observational design; however, RSI often is emergent, which likely would have complicated randomization. Further, a controlled trial could not have been conducted pragmatically because it would not have been ethical to randomize patients to RSI or to best practices or to delay sedation knowingly. The retrospective design prevented correction of potential inaccuracies and imprecisions of documentation within the EMR. However, a dedicated nurse routinely charted medication administrations in real time, minimizing measurement bias. Additionally, such imprecisions likely were consistent across the study cohort. It is also possible that pharmacists were present for some or part of RSIs in the group with no pharmacist present at the bedside, but careful review of redundant sources of documentation was performed to ensure accurate categorization. Second, this study presumed a rocuronium duration of 60 min regardless of weight-based dose or baseline patient characteristics. This relatively arbitrary duration of paralysis was based on review of available literature.[35] The duration of paralysis associated with rocuronium ranged from 33 to 193 min for doses of 0.9 to 1.2 mg/kg.[15] Patients with advanced age, impaired end-organ elimination, and electrolyte disturbances are known to be predisposed to prolonged paralysis. Therefore, the duration of paralysis likely was extended beyond 60 min for some patients, and thus the period of inadequate sedation was underestimated. To

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account for this possibility, a secondary outcome that presumed that paralysis persisted for up to 120 min was performed to simulate the effect of these factors. Further analysis of factors associated with prolonged paralysis (eg, renal and hepatic dysfunction) is important, but was beyond the scope of this study. Conversely, TOF was not measured in this study, and the duration of paralysis may have been < 60 min for some patients. Therefore, it is also possible that the rate and duration of inadequate sedation may have been overestimated. Moreover, the onset, peak, and duration of sedation is highly variable in this population, and as a result, sedation gaps may be greater or less than the calculated values for individual patients. No clear guidance for sedation dosing in this setting was available; therefore, the referenced sedative durations only were intended to model the sedation gap based on practice patterns. Additionally, the defined thresholds for adequate sedation were conservative, which may have led to an underestimation of the sedation gap.

Finally, patient recollection of awake paralysis was not assessed directly, and instead sedation gaps were used as a surrogate for the time during which a patient was at risk for awake paralysis. Notably, physicians may have provided more conservative doses of sedation based on bedside assessment of the patient's level of consciousness before intubation. The precise baseline level of sedation (eg, Richmond Agitation-Sedation Scale score) was not documented consistently, and therefore was not collected or analyzed. Evaluating the effect of inadequate sedation on clinical outcomes was beyond the scope of this study. Assessment of patient recollection requires an interview process after the patient is no longer sedated or delirious, which may not be practical. Therefore, measurement of sedation gaps remains a valuable evaluation tool to identify areas of opportunity for process improvement.

Key characteristics of current RSI workflow were measured and reported (eg, rocuronium dosing), but analysis of each step and decision was beyond the scope of the study. Additionally, some of the processes and tools (eg, TOF) were not considered standard of care. Nonetheless, a discussion of barriers to optimal RSI workflow may foster awareness and practice change. Further studies are needed to mitigate the risk of awake paralysis in critically ill patients.

Interpretation

In this study, a substantial proportion of patients did not receive adequate sedation after bedside procedural paralysis in the ICU. Given the psychological sequalae associated with awake paralysis, a need for clinical practice optimization and additional studies to further improve patient care remains.

Funding/Support

The authors have reported to *CHEST Critical Care* that no funding was received for this study.

Financial/Nonfinancial Disclosures

None declared.

Acknowledgments

Author contributions: I. A. M. had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. I. A. M. contributed to conception of the study, literature review, data acquisition and management, study design, data analysis, data interpretation, and writing of the article. J. J. D. contributed to conception of the study, study design, data analysis, data interpretation, and writing of the article. K. J. S. and R. L. F. contributed to conception of the study, study design, data interpretation, and writing of the article.

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